Report: *Pseudoscymnus tsugae* in Pennsylvania Forests

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Abstract

Since 1999, more than 34,000 predatory lady beetles, *Pseudoscymnus tsugae* Sasaji and McClure (*P. tsugae*), have been released by the Pennsylvania Bureau of Forestry to combat the hemlock woolly adelgid (HWA), *Adelges tsugae* Annand. These predators have been distributed among six sites in efforts to establish and colonize this beetle species and study reproductive, dispersal, and feeding habits. Successful overwintering of adult beetles has been confirmed at all 1999 and 2000 release sites. Sleeve cages studies in 2001 indicated that *P. tsugae* reproduces readily on HWA in Pennsylvania, producing at least two generations per year.

Keywords:

Pseudoscymnus tsugae, *Adelges tsugae*, Pennsylvania.

Report

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To date, successful establishment, measured in terms of successful overwintering of adult beetles, has been documented for the New Jersey beetles at all of the three 1999 to 2000 release sites (Figure 2). At the time of release, the 1999 Franklin site and the 2000 Pike site had post-peak HWA populations on the overstory hemlocks and peak populations on understory trees, and the 2000 Wayne site had peak populations throughout. Recoveries of *P. tsugae* larvae were made only at this 2000 Wayne site, where about 12 larvae were observed from one branch beating in June 2001 and more were found in July.

Year of Release	County	PA Region	Number Released	Stages Released	Release Date	Source
1999	Franklin	Southcentral	10K	Adults		NJ
2000	Wayne	Northeast	5K	Adults		NJ
	Pike	Northeast	5K	Adults		NJ
2001	Snyder	Central	5K	Eggs, Larvae & Adults	May 2	PA
	Perry	Central	5K	Eggs, Larvae & Adults	May 3 & 30	NJ & PA
	Northampton	East	4K	Adults	May 10	NJ
Total			34K			

Figure 1. *Pseudoscymnus tsugae* releases in Pennsylvania, 1999 to 2001.

Year of Release	Site / 2001	Apr	May	Jun	Jul	Aug	Sep	Oct
1999	Franklin		0		0	A		
2000	Wayne	A		A+L	A+L	A		A
	Pike	0		0	A		0	0
2001	Snyder		A+L	A+L	A	A		A
	Perry		A+L	A+L	A+L	A+L		A
	Northampton		A	A	A	A		0

Figure 2. *Pseudoscymnus tsugae* recoveries in Pennsylvania in 2001 (A = adults, L = larvae, 0 = none).

Releases in 2001 were made on heavily infested trees in pre-peak HWA populations, except at 2001 Northampton where HWA had peaked. Following these releases, beetle adults and larvae were observed from branch beatings at the two pre-peak sites where Pennsylvania *P. tsugae* had been released. At the 2001 Perry site, larvae were found as late as August 21. Attempts to identify potential larval prey this late in the season, in addition to settled HWA nymphs, revealed that many progrediens adults and unhatched eggs persisted in the woolly masses on the healthier hemlock terminals.

Sleeve cage studies in 2001 confirmed that these beetles continue to feed and breed throughout the spring and summer, producing new generations of predators for the following year (Figure 3).

Sleeve	6	12	14	7	11	8	13	1	10	2	3	15	4, 5 & 9
Date	28-Jun	11-Jul	11-Jul	26-Jul	26-Jul	7-Aug	7-Aug	17-Aug	17-Aug	3-Oct	3-Oct	3-Oct	2002
Adults	8	8	8	23	6	18	10	10	14	1	0	5	?
Larvae	0	0	0	1	1	1	0	0	0	0	0	0	?
	Redeploy								Redeploy				

Figure 3. *Pseudoscymnus tsugae* recoveries in Pennsylvania sleeve cages in 2001.

Fifteen 1 m sleeves were deployed on heavily infested hemlock branches on May 11. Adult-mated Pt (five males and 10 females), provided courtesy of ESI, were introduced into each sleeve. Sleeves were removed periodically throughout the summer, and carefully screened for *P. tsugae* adults and larvae. Evidence of prey extirpation and subsequent *P. tsugae* cannibalism led to sleeve redeployment onto fresh branches on June 29 and August 17. Two sleeves yielded more *P. tsugae* than were originally introduced.

As a result of these early successes, expanded release efforts are planned for 2002 that will nearly triple the numbers of beetles in Pennsylvania hemlock forests. In addition to beetles provided gratis by the USDA Forest Service and those in barter from New Jersey, 50,000 *P. tsugae* are being reared for Pennsylvania under contract with ESI. New release strategies being considered include inundative releases, earlier (April) releases, sequential releases, releases along local HWA gradients, releases of conditioned (acclimated) beetles, and releases of *P. tsugae* eggs and larvae.

Of the 14,000 *P. tsugae* released in 2001, 4,000 were received from New Jersey in barter for assistance from the Pennsylvania Bureau of Forestry in providing HWA collection sites for New Jersey rearing. These beetles were released in Henry's Woods at the Jacobsburg Environmental Education Center (2001 Northampton). From October 2001 through January 2002, 15 weekly collections of ca. 100 kg of host material were shipped to the New Jersey lab. Collections from Pennsylvania public lands by New Jersey personnel continue, as will weekly shipments, through the 2002 rearing season.

Work with other promising new species of ladybugs from China, *Scymnus* spp., also was conducted in field (sleeve) cages in 2001 in cooperation with Mike Montgomery, USDA Forest Service, Hamden. Additional work with these species in Pennsylvania is planned for 2002. In the absence of other large-scale control strategies, a complex of these biological control organisms may be the best long-term hope for the survival of our state tree.

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